to science as attend the Association meetings, rather than to the general public. Subscription lists were opened and money came in, not in overflowing abundance indeed, but yet in quantity sufficient to enable the operations to be begun. Further donations have been given, and the work has now been carried down to a depth of more than 1,000 ft.

It would be a great misfortune to science if this undertaking, after having been successfully carried so far, were now to be brought to an abrupt close for want of funds. Already the boring has put us in possession of some new and important facts in the geology of the south-east of England. It has shown that the well-known Kimmeridge clay stretches underneath the later Secondary rocks as a deep massive formation, some 700 ft. in thickness, and that it lies upon and appears to pass down into the Oxford clay without the intervention of the sandy and calcareous beds which usually separate the two deposits. The geological position of these clays is settled by means of the fossils, of which literally thousands have been taken out of the 2-in. core of rock brought up by the diamond-boring machine. It is intended, we believe, to sort the specimens and distribute them among different public museums. How much further the bore must be sunk before the remainder of the Secondary strata is pierced, to what horizons these strata will be assignable, and what will be their basement rocks, are the parts of the problem still to be solved.

Though undertaken chiefly in the interest of pure science, the project has likewise its economic aspects. It is eminently desirable to know whether any minerals of value lie among the Secondary rocks of the south of England, such as iron-stone, rock-salt, or gypsum; whether among the Palæozoic rocks underneath there is any possibility of obtaining workable coal or any of the other minerals which have made the Carboniferous formations so valuable a source of our wealth. It is likewise greatly to be wished that as full and accurate information as possible should be obtained regarding the nature of the rocks underneath with reference to the question of water-supply—a question which, important enough now, is certain before many years to become one of the most pressing social problems of the day.

On every ground, therefore, this most heroic attempt to provide data for settling some of these questions deserves hearty encouragement. On no account must it be allowed to come to an end till its express object is accomplished. If every well-wisher to science in this country would but send his contribution, not only would the present boring be conducted to a successful issue, but a great series of similar borings might be made all over the south of England. We understand that the Government, impressed with the interest and importance of the subject, has promised to contribute a sum of 1,000*l.* conditionally upon coal being found or on the boring being continued for another 1,000 ft. This aid will be valuable, but it evidently in the meantime does not supersede private efforts; it rather makes them more needful than ever. The undertaking is in excellent hands. Mr. Topley, of the Geological Survey, looks after its geological aspects. To Mr. Henry Willett, of Arnold House, Brighton, the zealous and indefatigable honorary secretary, the enterprise is mainly indebted for its financial progress so far. He has now appealed earnestly for further help, and to him we would urge all who take interest in these matters, and who have not already contributed, to send their donations, which, whether small or large, will at the present moment be of the most essential service. A. G.

THE SCIENCE OF PAINTING

Die Farbenlehre im Hinblick auf Kunst und Kunstgewerbe. Von Prof. Wilhelm von Bezold.

THERE are two ways of popularising science. We may take up one of its great branches and treat it so simply and clearly that even the unscientific reader may with proper attention gain some insight into the principles to which the recent great advances in science have been chiefly due; or we may take up a smaller field and treat it fully and with all its applications in everyday life. He who studies a subject by the latter method will have it constantly brought under his notice, and will thus be led to observe and perhaps to experiment, and to acquire for himself that method of looking at the phenomena of nature and reasoning about them which is necessary to the understanding of every great principle in science, but which is foreign to nearly all who have not had a scientific training.

The latter method, which no doubt will prove the most successful, has been chosen by Prof. von Bezold in his work on the theory of colours. No subject is better fitted to be treated in this way, because it is in everybody's power to make observations, and perhaps even to find out some new fact. It is, however, not the only, and not even the chief, object of the author to create merely an interest in his subject outside the scientific world. He wishes his book to be of real value to the artist and to help him by theoretical speculations to such combinations of colour as shall prove most effectual. It is very doubtful whether the book will be successful in this respect. No doubt it would be a great achievement if every artist could be induced to think about the cause of the various and curious effects which are brought about by contrast and combination of colours; we therefore recommend the careful perusal of Prof. von Bezold's book to every painter. In the present state of the theory of colours, however, the attention bestowed upon it by artists will be of greater value to the subject than to themselves. It would no doubt be injurious to art if the painter were guided in his work by a theory so long as that theory is incomplete.

Painters are, however, themselves best able to bring the theory of colours into a better state; a state in which it will be beneficial to themselves and repay them for their trouble.

Two things have chiefly struck us in Prof. von Bezold's book as adding to its value and interest. The first is the care which he has taken to give his experiments in such a way that anyone without the use of large and expensive apparatus can repeat them and test for himself the truth of the author's statements. The second is the great ingenuity with which the author explains by his theory so many of the phenomena which most of us daily observe. We note one particular instance. All who have worked much at absorption spectra must have been struck by the

change of colour which light of a certain wave-length undergoes when the intensity diminishes. Prof. von Bezold uses this curious fact to explain the peculiar colours seen in a landscape when viewed by moonlight, although the light reflected by the moon is identical in composition with sunlight.

In his account of the elementary principles of optics the author abandons the old method of dividing vibrations into heat rays, light rays, and actinic rays. We note this point as it is one which must soon play an important part in physics and will doubtless provoke much discussion. The author seems to prefer the following method of viewing the facts to the old one:—A body absorbs a certain class of rays peculiar to itself; whether these rays are converted into heat or into chemically active rays depends upon the peculiar properties of the body. In order, however, to include in this statement all the facts included in the old division, we must add that, as a rule, bodies absorbing the ultra-violet rays are thereby rendered more chemically active, and, as a rule, bodies absorbing the red are thereby heated. This method of looking at the matter seems to us to be the one most closely agreeing with the facts. Prof. von Bezold gives, as a proof that the red rays may be chemically active, the fact that, as the green colouring matter of leaves absorbs the red end of the spectrum as well as the blue, the red rays alone are sufficient to sustain life in the plant. He might have referred to the recent discovery of Vogel, who photographed the red end of the spectrum by mixing a red colouring matter with bromide of silver; and, on the other hand, to the fact observed by Budde, that chlorine is heated by the ultra-violet rays. The third chapter contains a short and clear abstract of recent researches on compound and primary colours. We would call attention specially to the passage in this chapter on colour and sound, in which the author refers to the influence of dwelling too much on the analogy between sound and light. Analogies are a very dangerous help to teachers, and are used by far too often. It requires at least a partial knowledge of the subject to see where the analogy begins and where it ends. Students generally either do not see where the analogy really lies, or want to carry it too far; a good many erroneous notions are thereby acquired.

The most interesting chapter in the book, however, is the one on Contrast of Colours; the examples are well chosen, and the coloured illustrations in the accompanying plates are in all cases convincing. The author shows with great success how little we may trust our own eyes as regards colour, and how difficult and even impossible it is to form a correct judgment of the relative darkness of two shaded fields, so long as they are not on the same ground.

The last chapter, which treats of the combination of colours, is necessarily the least complete; it shows, however, that the application of the theory to the arts has fairly begun. It has already been said that this beginning does not justify us in demanding from painters obedience to rules which have not been proved to be valid without exception. It may be easy to discover the application of these rules in acknowledged masterpieces, and yet be difficult to state them in such an exhaustive way that compliance with them will in all cases lead to perfect harmony. So long as this is not done it must not be expected that the painter will derive substantial help from the theory of colours.

ARTHUR SCHUSTER

OUR BOOK SHELF

Illustrations of the Principal Natural Orders of the Vegetable Kingdom. Prepared for the Science and Art Department of the Council of Education. By Prof. Oliver, F.R.S., F.L.S. (London, Chapman and Hall, 1874.)

FEW books published of late years will be of greater practical value to the botanical teacher or student than this. The want has long been painfully felt of a work which will give in as few words as possible the salient characters of each of the more important natural orders, unencumbered by minutiæ of structure which concern only the more advanced student. This want we have here most admirably supplied, not only by 150 pages of text, but by upwards of 100 plates, which present in the most lucid form a representation (plain or coloured, as may be preferred) of a section and "diagram" of a flower belonging to many orders, together with a drawing of the fruit, seed, or other organ the structure of which is of special importance. The very comprehensive title of the work might, unless the contrary is pointed out, lead to a little disappointment, when it is found that the descriptions, and still more exclusively the plates, refer almost entirely to the more important *European* orders; very brief accounts, or in some cases none at all, being given of such remarkable extra-European groups as the Cycadeæ, Gnetaceæ, Proteaceæ, Bignoniaceæ, Piperaceæ, and others. As far as European botany is concerned, we cannot conceive that the work could have been better carried out. The plan which has been adopted of treating separately groups which are united together into a single order in our more advanced text-books—as for instance Fumariaceæ as distinct from Papaveraceæ; Oxalideæ and Tropæolaceæ from Geraniaceæ, and Droseraceæ from Saxifragaceæ—seems to us altogether commendable in a work designed especially for beginners. There has long been felt a desire that in text-books of botany the morphological and physiological portion should be divorced from the systematic and descriptive. We trust that in future this may be carried out, and that writers of text-books will confine themselves to the former branch, leaving the student to gain his elementary knowledge of the latter branch from special works like the one before us.

A. W. B.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Photographic Irradiation

IN answer to Mr. Ranyard (NATURE, vol. x. p. 205), I have to state that the opaque bar in my experiments was placed as close to the collodion as possible without touching it, not farther than ·01 in. from it, and that there were no photographic traces of diffraction bands.

Allow me now to suggest a possible explanation of the different results given by Mr. Ranyard's and my own experiments. One important difference in the arrangement of the two experiments was, that in the one case the opaque bar was in contact with the collodion, and in the other case it was placed at a very short distance from it. In the experiments with the bar in contact with the collodion, the nitrate of silver solution on the surface of the plate would not form a true plane but would be curved upwards at the edge of the bar; and further, this curve would not be regular, but would have irregularities corresponding to every irregularity in the edge of the bar. This irregular curved fluid surface would cause irregular refraction of the light